Space Weather Technical Forecast

Issued on Friday, 22 March 2024 at 00:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares likely (R1-R2 Radio blackouts), slight chance of X-flares (R3 blackouts). Slight chance of G1/Minor Storm intervals following the CME arrivals early Day 1 (22 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Low, with the largest flare a C8.7 peaking at 21/1132 UTC from AR3615 in the southeast. There are currently ten sunspot regions on the visible disc. The regions of most interest are AR3614 in the northeast (likely ex-3590 from the previous rotation which gave three X-flares, including X6.3 the largest of the solar cycle so far) and AR3615 in the southeast. AR3615 has a number of smaller spots and is showing a couple of delta regions. It has been responsible for most of the observed flare activity. AR3618 has grown rapidly over the past day, and now has multiple spots with penumbra, but flare activity has been minimal so far. The remaining regions currently appear stable or showing slight decay.
No new Earth directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as observed by DSCOVR at L1 have been at background levels throughout the last 24 hours, around 330-360 km/s. Density was around average or below at first, but showed an increase to slightly above average around 21/0150UTC at the same time as a step change in speed, due to a weak CME arrival. A further significant jump in density occurred around 21/1511UTC, again likely caused by a weak CME arrival. Interplanetary Magnetic Field (IMF), Bt, was weak at first, but increased to a peak of 15nT with the first CME arrival. The north-south component, Bz, varied weakly at first, then more strongly after the two CME arrivals, between +11 and -12 nT after the second CME, this was followed by an extended period of negative Bz. Phi was largely positive (away from the Sun) after the first CME, but has been neutral after the second CME arrival. Geomagnetic activity was Quiet to Unsettled (Kp1-3) becoming Active (Kp4) with one minor geomagnetic storm interval (G1/Kp5) between 21/1500-1800UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The observed 24-hour fluence was below the Active threshold, with a value at 22/0001 UTC of 9.86e5 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is likely with a slight chance of becoming High with any isolated X-flares, mostly due to AR3614 and AR3615.

Solar Wind / Geomagnetic Activity: A complex filament eruption on 17 Mar saw two possible Earth-directed CMEs, which both likely arrived through the period. The first arrival was around 21/0150UTC, the second around 21.1513UTC . The solar wind remained at background levels indicative of weak CMEs. A coronal hole fast wind from CH12/- may cause an enhancement later on Day 3 (24 Mar).
Geomagnetic activity is expected to be Unsettled to Active at first, with a slight chance of G1/Minor Storm intervals (Kp5). Effects are then likely to decline into the second half of Day 1 (22 Mar), becoming largely Quiet for Day 2 (23 Mar). Towards the end of Day 3 a coronal hole fast wind may connect with Earth, with geomagnetic activity possibly becoming Unsettled-Active (Kp3-4) with a slight chance of G1 minor geomagnetic storms before declining again on Day 4 (25 Mar).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux at GOES18 is expected to remain around background levels, with a slight chance of enhancements. This risk increases slightly through the period as AR3614 and AR3615 rotate towards centre disc. High energy electron flux (greater than 2MeV) is expected to persist at mainly background levels with the associated 24 hour fluence remaining below the Active threshold.

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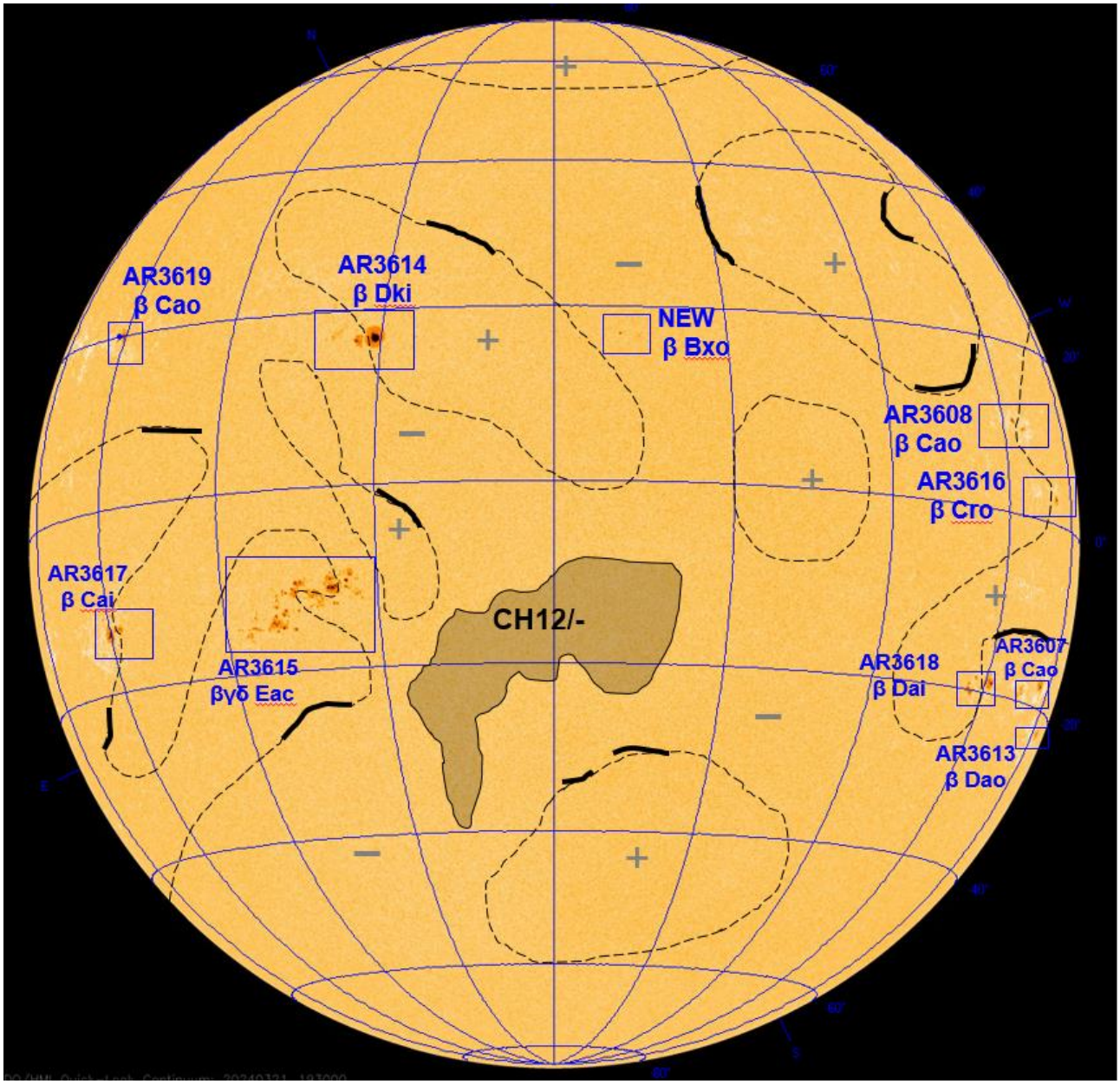
Figure 1. Solar Analysis Valid 21/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME was observed from a filament eruption from the southeast disc, occurring near AR3613 at around 17/0230 UTC. This was a complex eruption, splitting into two separate CMEs. The first one went to the southeast, and was faster, narrower but brighter on imagery, possibly giving a glancing impact around 21/0150UTC. The second to the southwest was fainter, slower and wider, and may have arrived around 21/1513UTC. No more CMEs are expected to arrive during the forecast period.

Coronal hole CH12/- is located near to centre disc, and may cause an enhancement in solar winds later on Day 3 (24 Mar). On its previous rotation this coronal hole saw solar wind speeds of around 450 km/s, with similar speeds expected once again, however there was little in the way of geomagnetic activity. As we are currently now around the Spring Equinox, negative polarity coronal holes will give more intense geomagnetic activity, so some enhancement is possible this time.

Geomagnetic activity is expected to be Unsettled to Active at first. with a slight chance of G1/Minor Storm intervals (Kp4-5). Effects are then likely to decline into the second half of Day 1, becoming largely Quiet for Day 2 (23 Mar). Towards the end of Day 3 (24 Mar) a coronal hole fast wind from CH12/- may become geoeffective, with geomagnetic activity becoming Unsettled-Active (Kp3-4) with a slight chance of G1 minor geomagnetic storm intervals, before declining during Day 4 (25 Mar).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	10	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections- Nil

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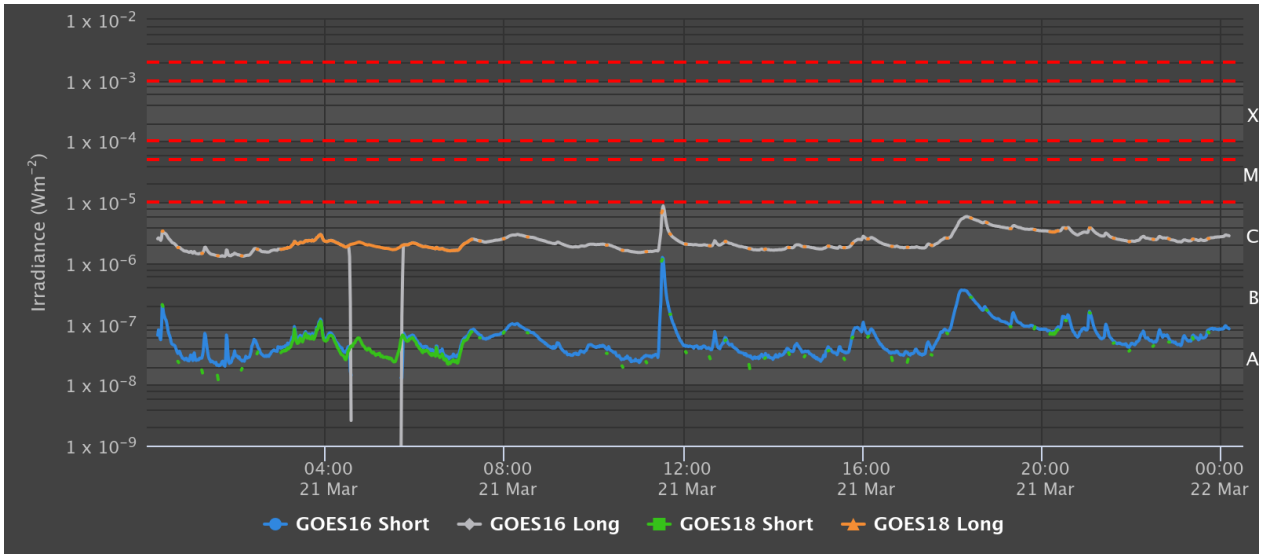
Radio Blackouts - X-Ray Flares:
Activity has been Low, with the largest flare a C8.7 peaking at 21/1132 UTC from AR3615 in the southeast.

There are currently ten sunspot regions on the visible disc. The regions of most interest are AR3614 in the northeast (likely ex-3590 from the previous rotation which gave three X-flares, including X6.3 the largest of the solar cycle so far) and AR3615 in the southeast. AR3615 has a number of smaller spots and is showing a couple of delta regions. It has been responsible for most of the observed flare activity. AR3618 has grown rapidly over the past day, and now has multiple spots with penumbra, but flare activity has been minimal so far. The remaining regions currently appear stable or showing slight decay.
No new Earth directed CMEs have been observed in the last 24 hours.
Moderate activity is considered likely with a slight chance of becoming High from any isolated X-flares, mostly due to AR3614 and AR3615.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 2: GOES16 X-Ray flux



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18 is currently at background levels. Flux is expected to remain at or close to background at first, with further enhancements unlikely. As AR3614 and AR3615 rotate towards centre disc through the period, they move into a slightly better location for proton events to reach Earth and the probability of reaching S1 rises a little.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

GOES-16 electron flux is expected to remain at mostly background levels. As the CME influence eases a rise in electron flux is possible as the van Allen belts expand back out again, but this is unlikely to be significant.

As a result, the associated 24 fluence is expected to remain below the Active threshold, albeit with a very slight rise in probability through the period. MOSWOC REFM is thought to be giving good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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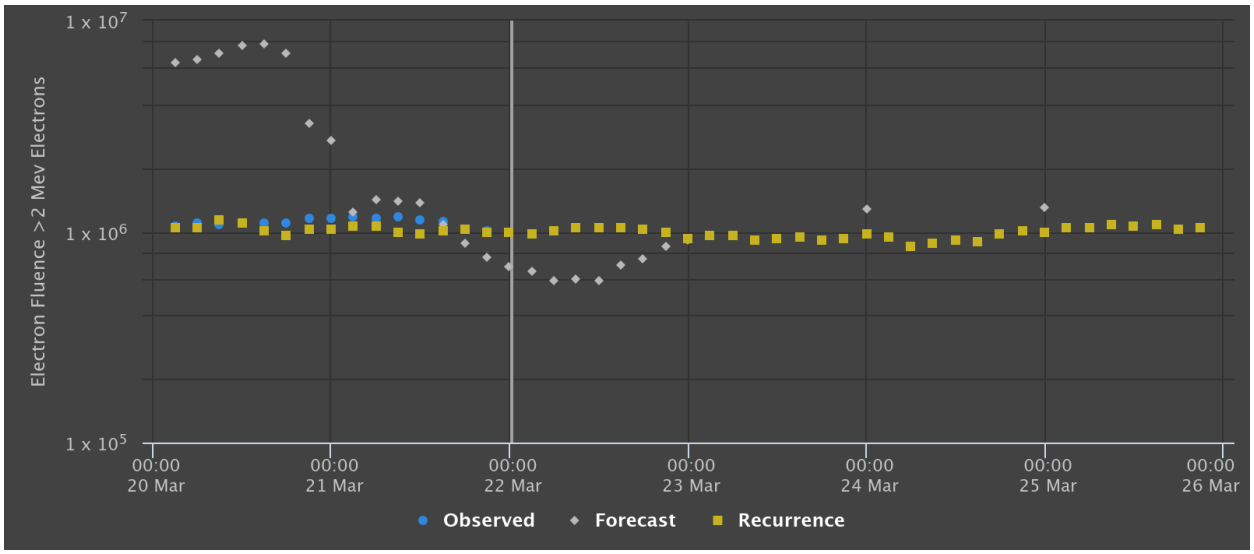
Figure 3: MOSWOC REF Model



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